

# Claims

- [c1] A bipolar transistor (HBT), comprising:
  - a collector including a frustum-shaped collector pedestal having an upper surface, a lower surface, and a slanted sidewall extending between said upper surface and said lower surface, wherein said upper surface has substantially less area than said lower surface;
  - an intrinsic base overlying said upper surface of said collector pedestal;
  - an emitter overlying said intrinsic base; and
  - a raised extrinsic base conductively connected to said intrinsic base.
- [c2] A bipolar transistor as claimed in claim 1 further comprising a region including at least one material selected from dielectrics, lightly-doped semiconductors, and intrinsic semiconductors contacting said slanted sidewall of said collector pedestal.
- [c3] A bipolar transistor as claimed in claim 1 wherein said collector pedestal is formed by epitaxial growth on top of a single-crystal semiconductor layer.
- [c4] A bipolar transistor as claimed in claim 1 wherein said

collector pedestal is formed by etching a single-crystal semiconductor layer.

- [c5] A bipolar transistor as claimed in claim 2 wherein said region includes a layer of silicon nitride extending between a shallow trench isolation and said slanted sidewall of said collector pedestal.
- [c6] A bipolar transistor as claimed in claim 5 further comprising a dielectric spacer, wherein said raised extrinsic base is self-aligned to said emitter and spaced from said emitter by said dielectric spacer.
- [c7] A bipolar transistor as claimed in claim 1 wherein said emitter is self-aligned to said collector pedestal.
- [c8] A bipolar transistor as claimed in claim 7 wherein a centerline of said emitter is aligned to a centerline of said collector pedestal.
- [c9] A bipolar transistor as claimed in claim 8 wherein said emitter and said collector pedestal are formed in a photolithographically patterned opening in a layered stack of materials.
- [c10] A bipolar transistor as claimed in claim 1 wherein said intrinsic base includes a layer of a single-crystal semiconductor which forms a heterojunction with at least one

of said emitter and said collector pedestal.

- [c11] A method of making a heterojunction bipolar transistor (HBT), comprising:
- forming a collector including a frustum-shaped collector pedestal having an upper surface, a lower surface, and a slanted sidewall extending between said upper surface and said lower surface, wherein said upper surface has substantially less area than said lower surface;
  - forming an intrinsic base overlying said upper surface of said collector pedestal;
  - forming an emitter overlying said intrinsic base; and
  - forming a raised extrinsic base.
- [c12] A method of making a bipolar transistor as claimed in claim 11 further comprising providing a region contacting said slanted sidewall of said collector pedestal, said region consisting essentially of one or more materials selected from dielectrics, lightly-doped semiconductors, and intrinsic semiconductors.
- [c13] A method of making a bipolar transistor as claimed in claim 11 wherein said collector pedestal is formed by epitaxial growth on top of a single-crystal semiconductor layer.
- [c14] A method of making a bipolar transistor as claimed in

claim 11 wherein said collector pedestal is formed by etching a single-crystal semiconductor layer.

- [c15] A method of making a bipolar transistor as claimed in claim 11 wherein said region includes a layer of silicon nitride extending between a shallow trench isolation and said slanted sidewall of said collector pedestal.
- [c16] A method of making a bipolar transistor as claimed in claim 15 further comprising forming a dielectric spacer on an inner sidewall of said raised extrinsic base adjacent to said emitter, wherein said raised extrinsic base is spaced from said emitter by said dielectric spacer.
- [c17] A method of making a bipolar transistor as claimed in claim 11 wherein said emitter is self-aligned to said collector pedestal.
- [c18] A bipolar transistor as claimed in claim 17 wherein a centerline of said emitter is aligned to a centerline of said collector pedestal.
- [c19] A bipolar transistor as claimed in claim 18 wherein said emitter and said collector pedestal are formed in a photolithographically patterned opening in a layered stack of materials.
- [c20] A method of making a bipolar transistor as claimed in

claim 11 wherein said intrinsic base includes a layer of a single-crystal semiconductor which forms a heterojunction with at least one of said emitter and said collector pedestal.